DOOSAN **Document Transmittal** Upper Trishuli-1 HEP (216MW)		Date 2022-06-08	DT No.: UT1-HEP-DHI-PC-D-0035	SHEET 1 OF 1
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SUBJECT	Review Note RN-0136_Excavation and Support Drawings of Headrace Tunnel			

S. N.	REVIEW NOTE NO.	REVIEW STATUS	DWG. / DOC. NO.	REV.	DWG. TITLE / DOC. DESCRIPTION	REMARK
1	RN-0136	AN	UT1-C-150-CVL-DG-54002	0A	Excavation and Support Drawings of Headrace Tunnel	
2						
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Received by :

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Legend of Review Status
A : APPROVED
AN : APPROVED AS NOTED
RR : RETURN FOR RESUBMISSION
FI : FOR INFORMATION

DHI STAMP

Issued by DHI

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Doosan Heavy Industries & Construction Co., Ltd.

Discipline : Civil

UPPER TRISHULI-1 HEP (216MW)			
Client	**Nepal Water and Energy Development Company Private Limited**		
Owner's Engineer	**Tractebel Engineering GmbH / Jade Consult**		

REVIEW NOTE

Contractor	**Doosan Enerbility**		
Title of the Document	Excavation and Support Drawings of Headrace Tunnel		
Document No.	UT1-C-150-CVL-DC-54002	Revision	0A
Date of Documents	31.05.2022	Received Date	02.06.2022
Transmittal Form No.	UT1-HEP-DHI-D-0253		
Previous Review Date/Status	N/A	Prev. Review Note No.	N/A
Review Note No.	**RN-0136**	**Present Review Date**	**07.06.2022**
		Present Review Status	**AN**

A: Approved AN: Approved as Noted RR: Returned for Resubmission FI: For Information, only

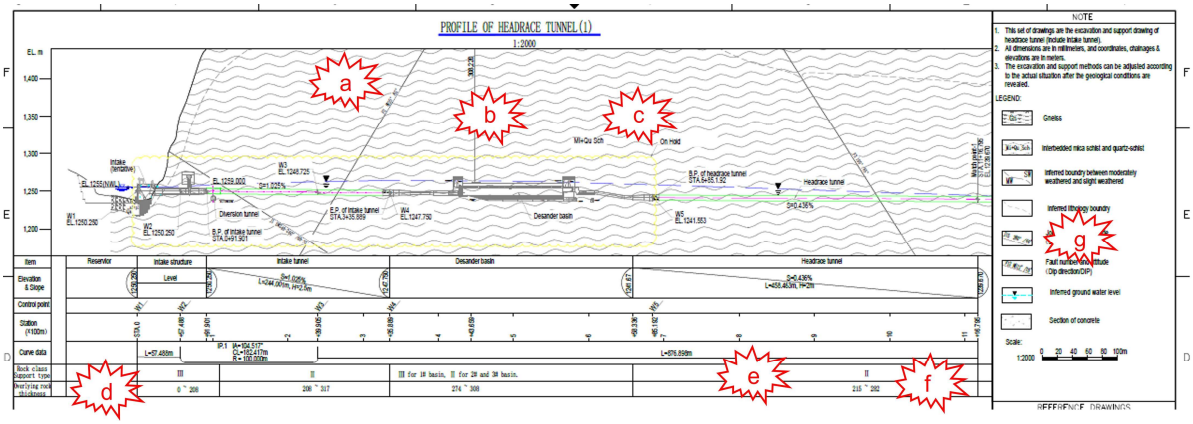
General Comments

The same general comments regarding the design of the Headrace Tunnel as a waterway in the UT-1 Project apply as given in the RN-135, dated 06 June 2022, in particular:

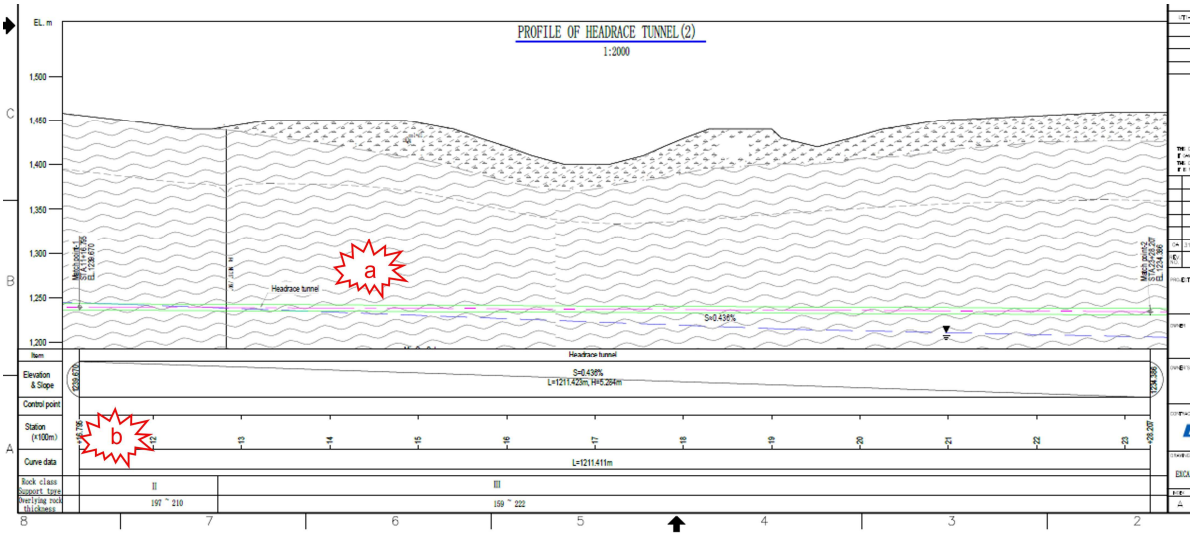
Any approval given refers to the constructability and stability of the underground structure as such, but it does not refer to the design of this tunnel serving as waterway in the UT-1 Project. It is the solely responsibility of the Contractor to proof, with an appropriate design, that this underground structure with the suggested geometry and support can serve as waterway in the project.

Regarding the predicted geological conditions along the alignment, latest experience from driving tunnels in the project needs to be incorporated. The entire document needs to be updated in this respect. The valuable results of the refraction seismic investigations at Haku Beshi need to be incorporated. Faults and their location shown in the drawings so far are considered to be purely speculative. An estimate of number of faults and their thickness needs to be made and manifested in the legends of the drawings. There is sufficient experience on geology available from the driven tunnels, which currently exceed in length more than 1 km, in total, to come up with a refined estimate of rock classes along the alignment. Such estimate will also allow to update advance rates necessary to better delineate the construction schedule.

Drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A

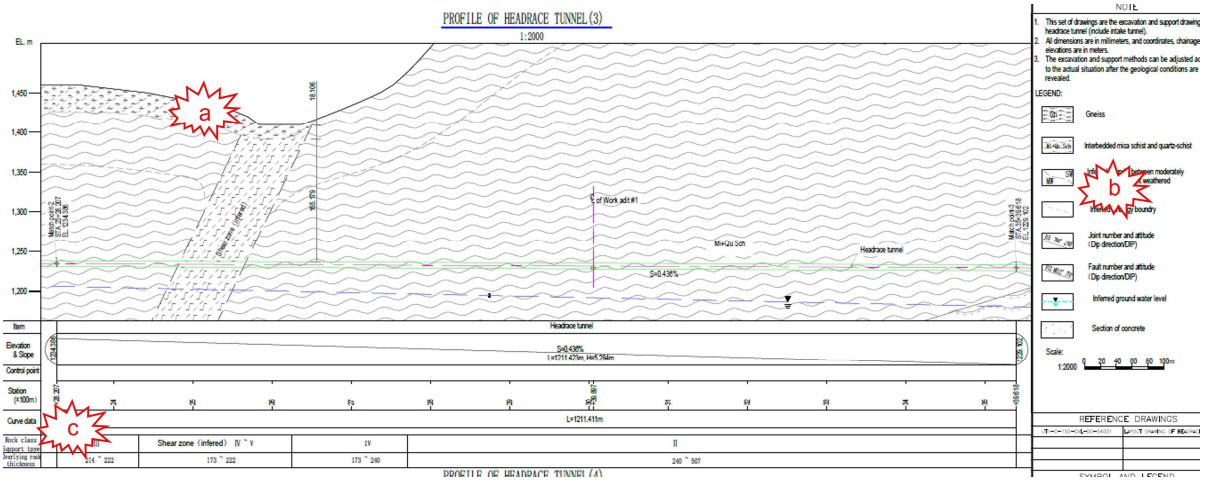


(a) Omit indicating faults where not been proven for certain.
(b) Clearly indicate the area where construction is on hold, exclude Diversion Tunnel.
(c) It is understood that the Contractor intends to continue with the Flushing Tunnel to reach – with the additional Connecting Tunnel, the HRT. Indicate.
(d) Provide in this and in respective sheets, drawings No. UT1-C-150-CVL-DC-54002 (sh. 2/10-5/10), version 0A, always the horizontal cover thickness at tunnel level. This is relevant to estimate potential water losses, if the tunnel liner will be perforated.
(e) Subdivide cover thickness in 100s of meters and the boundary where support in individual rock classes (here Class IV) changes.
(f) Revaluate excavation classes using the current knowledge from excavated tunnels.
(g) Revaluate entire geological legend using the current knowledge from excavated tunnels.

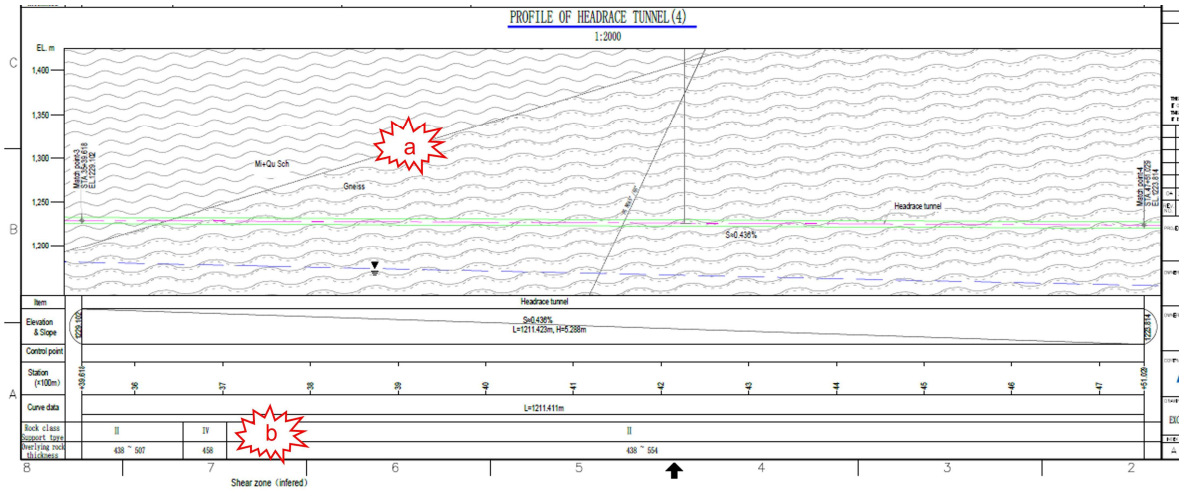


(a) As above under item (a).
(b) Update profile as above under items (e), (f) and (g).

Drawing No. UT1-C-150-CVL-DC-54002 (sh. 2/10), version 0A

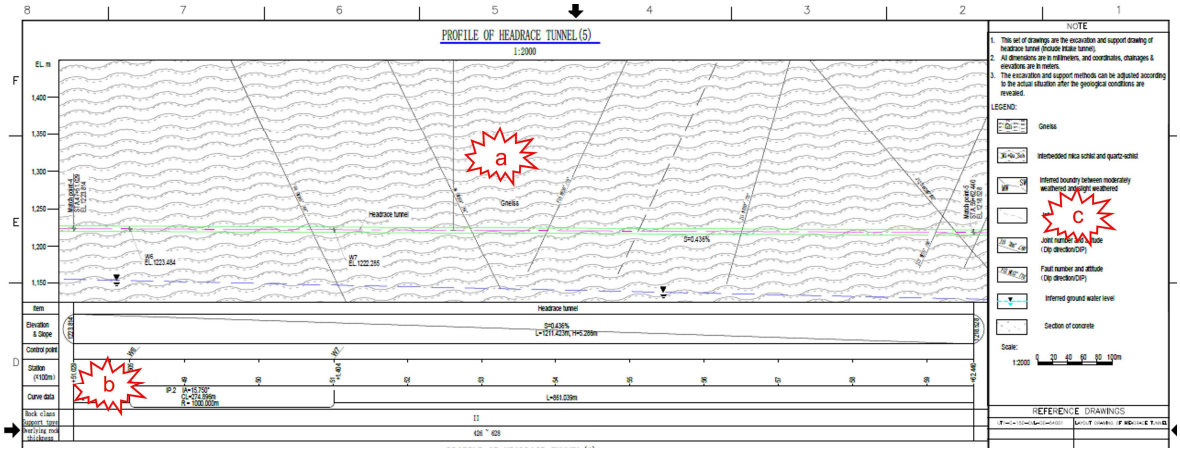


(a) Incorporate results of the refraction seismic investigations regarding the Haku Beshi Shear Zone.
(b) Update legend as requested for drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.
(c) Update cover thickness and overburden details as requested for drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.

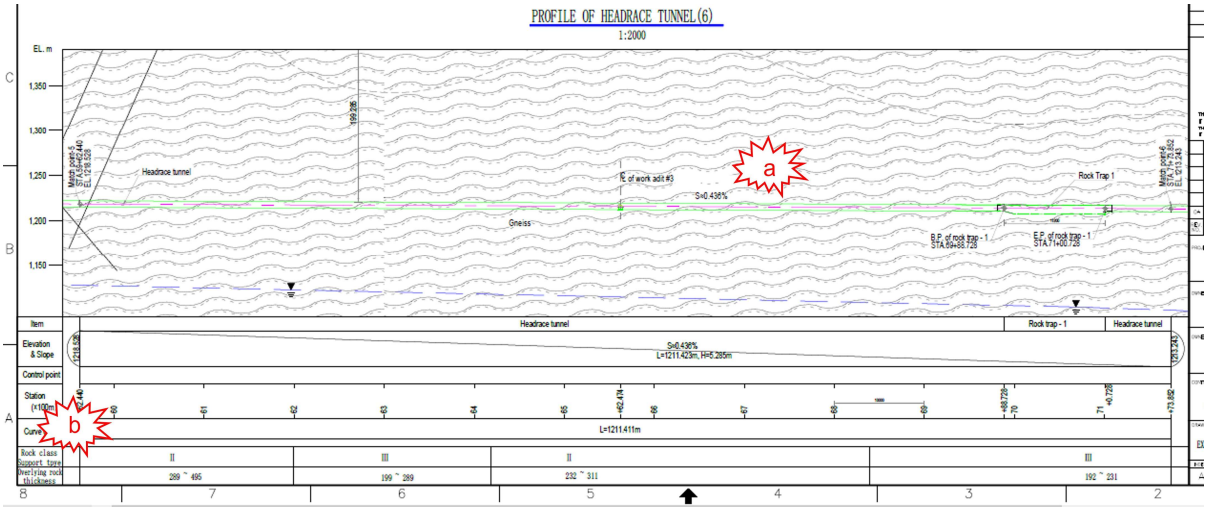


(a) Update geology and omit speculative faults.
(b) Update cover thickness and overburden details as requested for drawing No. Drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.

Drawing No. UT1-C-150-CVL-DC-54002 (sh. 3/10), version 0A

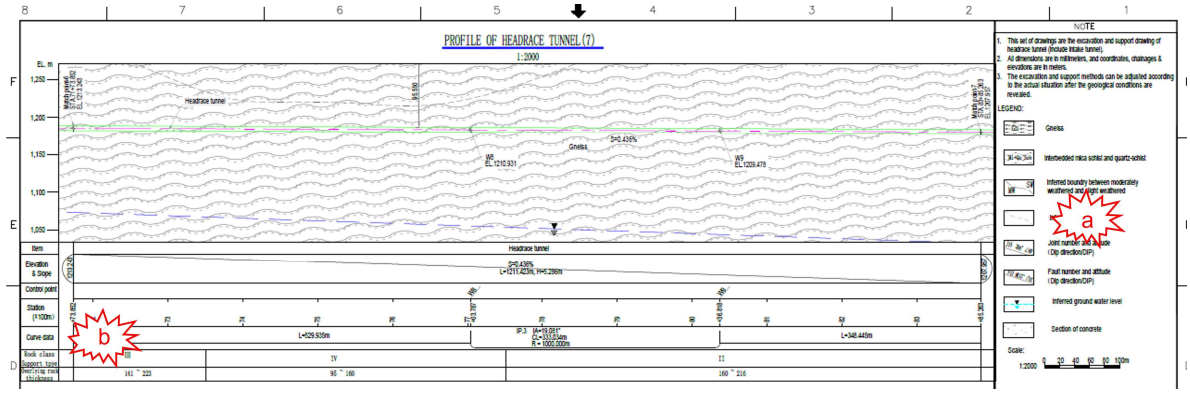


(a) Update as requested for drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.
(b) Update as requested for drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.
(c) Update as requested for Drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.

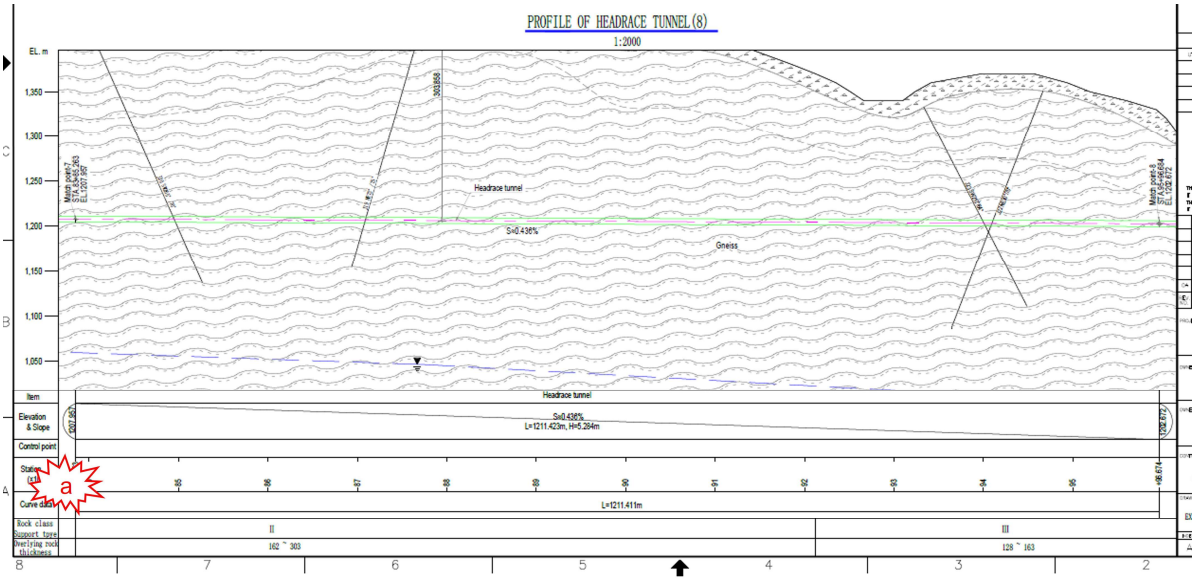


(a) Update as requested for drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.
(b) Update as requested for drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.

Drawing No. UT1-C-150-CVL-DC-54002 (sh. 4/10), version 0A

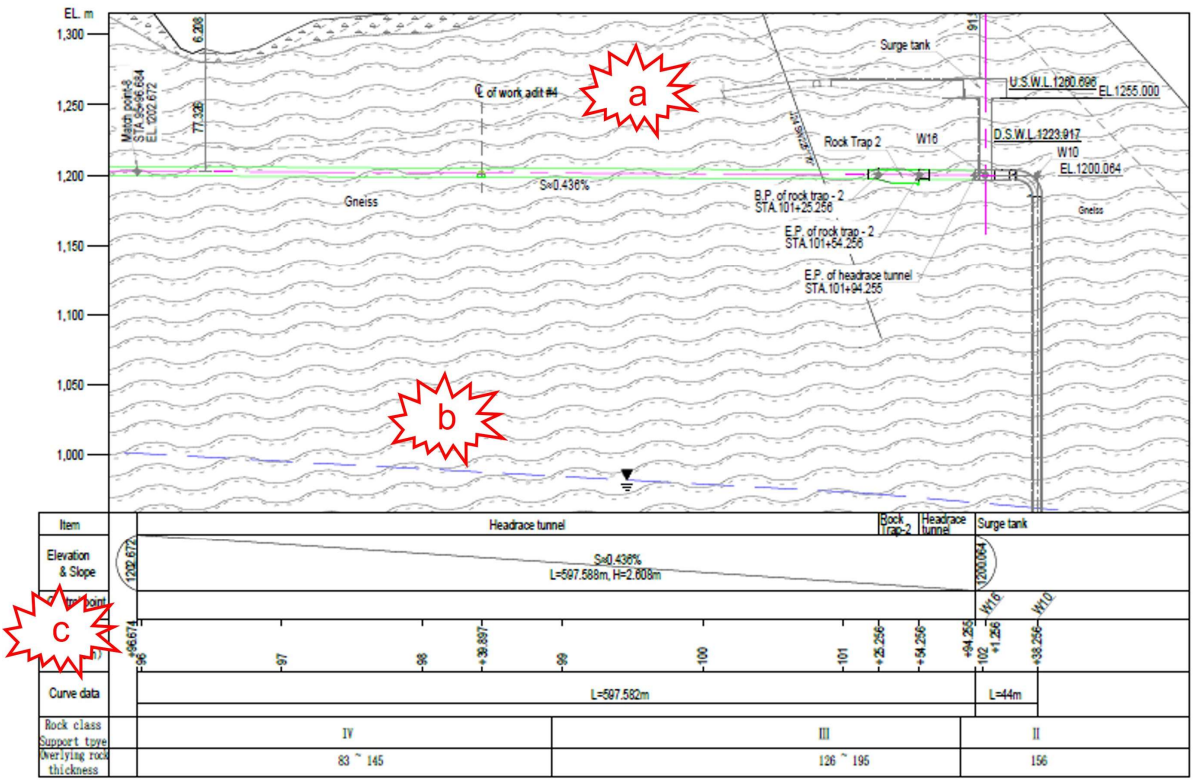


(a) Update as requested for drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.
(b) Update as requested for drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.



(a) Update as requested for drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.

Drawing No. UT1-C-150-CVL-DC-54002 (sh. 5/10), version 0A



(a) Update with current layout of Surge Tank, if necessary.
(b) The groundwater table is certainly not expected at this level. Update with new knowledge on geology.
(c) Update as requested for drawing No. UT1-C-150-CVL-DC-54002 (sh. 1/10), version 0A.

OCCURRENCE OF JOINTS

Joint No.	Dip direction	Dip	Tunnel direction
J1(foliation)	340–350°	20°	S53°W–S69°W
J2	18	82°	
J3	123°	80°	
J4	110°	10°	

a

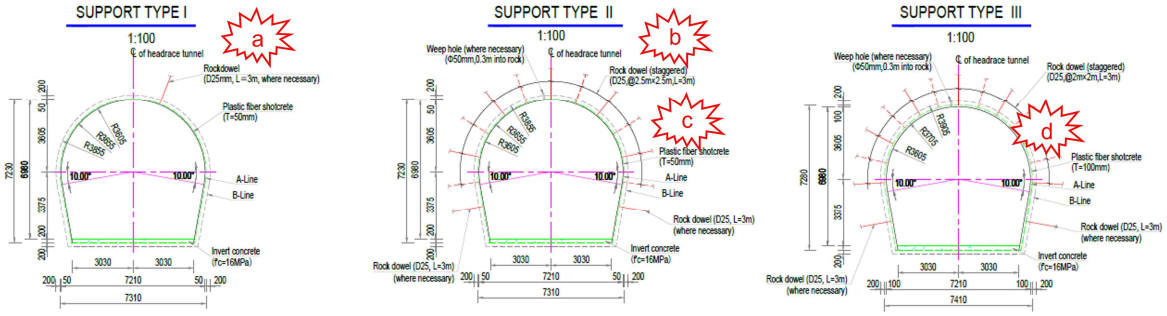
MECHANICAL PARAMETER OF JOINTS

Joint type	JRC	JCS, (MPa)	C, (MPa)	ϕ, (°)
foliation	6–8	70	0.20	35.0
lithoclasts cementted(J2、J3、J4)	8–12	50	0.15	28.8

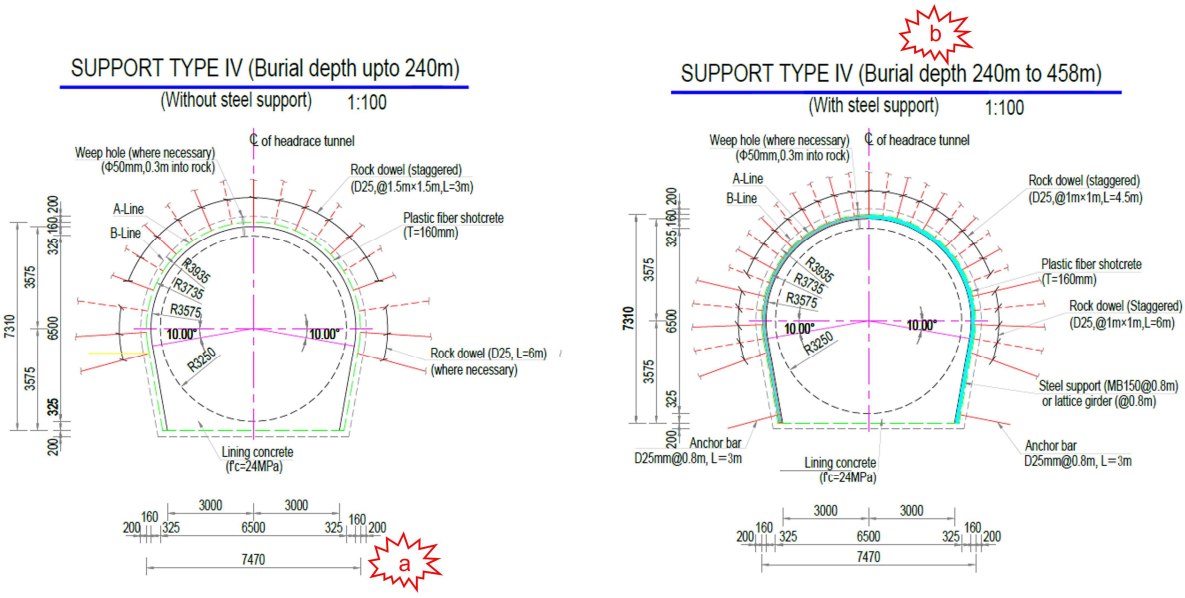
b

(a) Orientation of discontinuities, if available from new data, shall be provided on the individual sheets along the alignment. Providing a summary as shown for the 10 km long alignment is inappropriate. Omit.
(b) Discontinuity strength data shall be provided in the Calculation Report - and justified, but not for the entire alignment of the 10 km long tunnel. Omit.

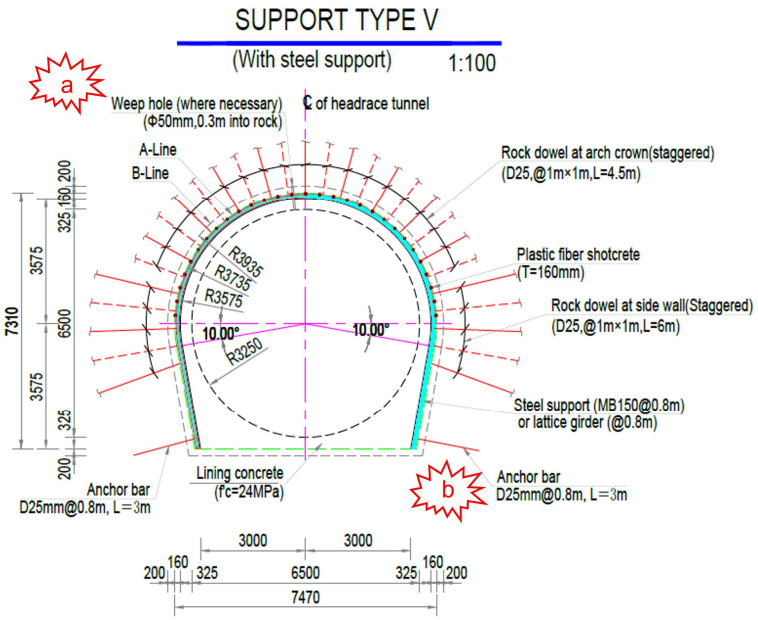
Drawing No. UT1-C-150-CVL-DC-54002 (sh. 6/10), version 0A



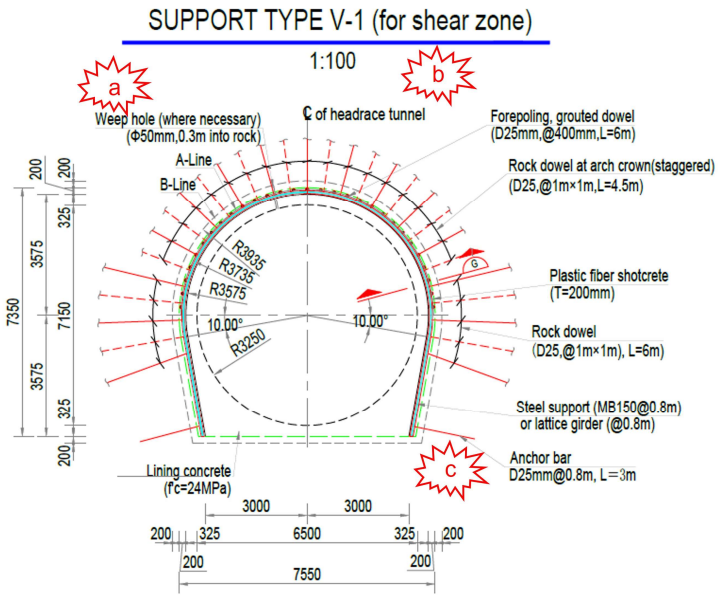
(a) No shotcrete liner in Class I rock. Replacement of strong and solid rock to comparatively weak shotcrete shall be avoided.
(b) Countercheck with waterway design assumptions ref weep-holes.
(c) 50 mm of shotcrete is certainly insufficient for a waterway with more than 7 m span. Revise.
(d) Consider appropriate thickness of shotcrete for Class III for this 7 m span waterway. Revise.


SUPPORT TYPE IV (Burial depth upto 240m)
(Without steel support) 1:100
℄ of headrace tunnel
Weep hole (where necessary) (Φ50mm,0.3m into rock)
Rock dowel (staggered) (D25,@1.5m×1.5m,L=3m)
Plastic fiber shotcrete (T=160mm)
A-Line
B-Line
Rock dowel (D25, L=6m) (where necessary)
Lining concrete (f'c=24MPa)
a
b
SUPPORT TYPE IV (Burial depth 240m to 458m)
(With steel support) 1:100
Rock dowel (staggered) (D25,@1m×1m,L=4.5m)
Plastic fiber shotcrete (T=160mm)
Rock dowel (Staggered) (D25,@1m×1m,L=6m)
Steel support (MB150@0.8m) or lattice girder (@0.8m)
Anchor bar D25mm@0.8m, L=3m

(a) With or without steel rib supported tunnel have same dimensions as shown. Steel rib must not be part of the reinforced concrete liner. Revise tunnel geometry, concrete and shotcrete thickness.
(b) Countercheck with tunnel longitudinal section regarding overburden. Specify TYPE IV for overburden thickness > 240 m.

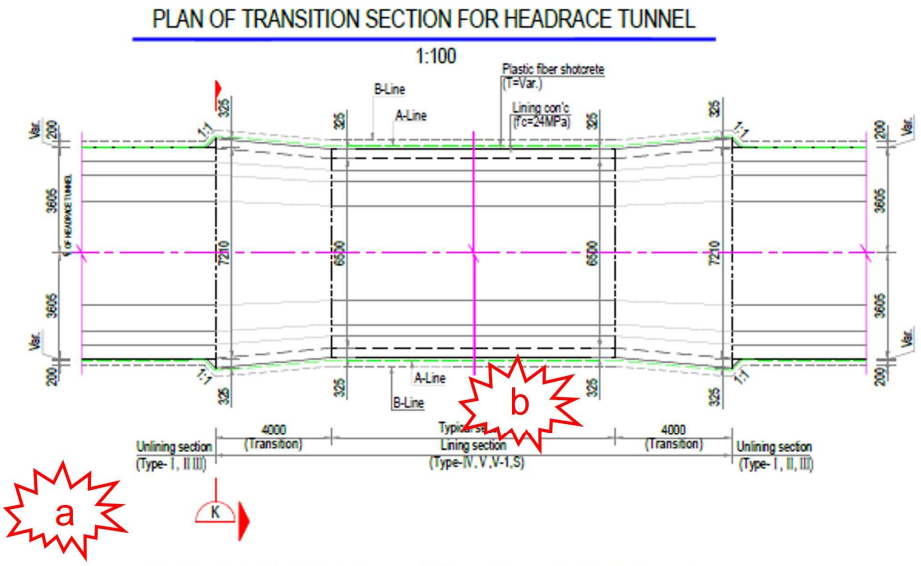


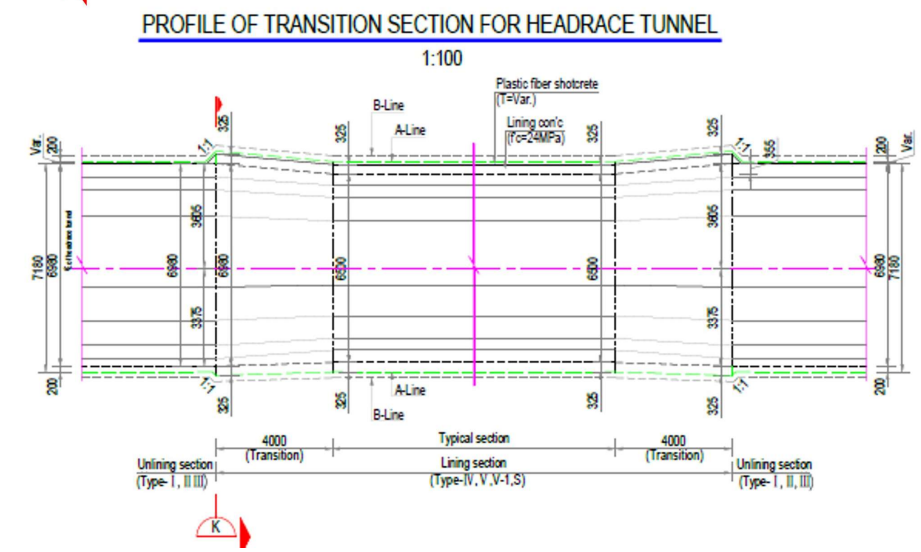
(a) Indicate consolidation / ground improvement measures.
(b) Indicate steel invert strut ("if necessary") and specify type of steel strut.



(a) Subdividing Classes V and Class V-1 may not be necessary. Consider.
(b) Detail ground improvement measures. Grouting, canopy tubes and other supplementary measures.
(c) Indicate steel invert strut ("if necessary") and specify type of steel strut.

Drawing No. UT1-C-150-CVL-DC-54002 (sh. 7/10), version 0A





(a) Both drawings show the same geometrical layout and same content. Revise.

(b) Transition from 7.3 m dia shotcrete liner to 6.5 m dia concrete lined section may not be in compliance with hydraulic requirements. Countercheck.

TUNNEL SUPPORT PATTERN

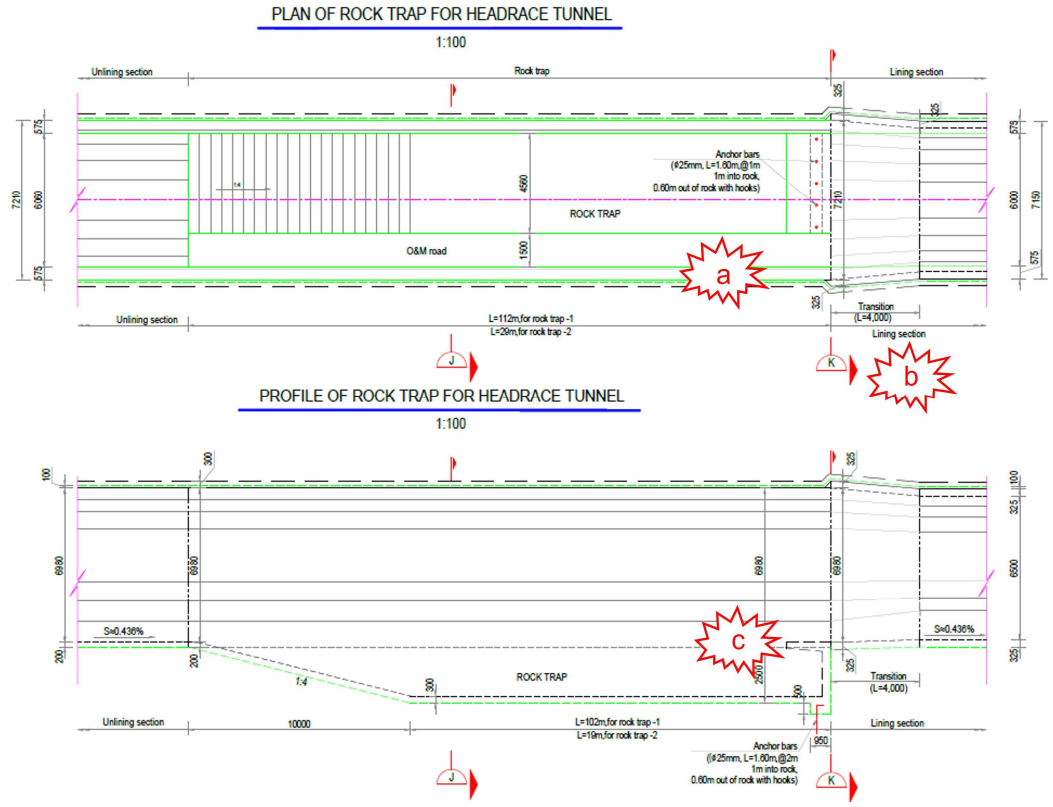
Rock mass quality	40<Q	10<Q<40	4<Q<10	1<Q<4	1<Q<4	Q<1	Shear zone	Passing above the diversion tunnel
Q value of rock mass quality for calculation	40	25	7	2.5	2.5	0.5	0.5	7
Support type	I	II	III	IV (Without steel support)	IV (With steel support)	V	V-1	S
Inner diameter(m)	7.21			6.5				
Excavation Parameter								
ESR	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Excavation span(m)	3	3	2	1.5	1.5	0.5~1	0.5~1	2
Calculated MUS*(m)	13	11	6	4	4	1	1	4
MUS* for shotcrete application(m)	11	11	4	2	2	1	1	2
MUS* for rock dowel installation(m)	6	6	4	4	4	0.5~1	0.5~1	4
MUS* for steel support installation(m)					0.5~1	0.5~1	0.5~1	
Excavation method	Blasting				Blasting/mechanically	Mechanically		
Initial support parameters								
Weep hole, Φ50mm,L=0.3m	where necessary							where necessary
Plastic fiber shotcrete,fc=25MPa	T=50mm	T=50mm	T=100mm	T=160mm		T=160mm	T=200mm	T=120mm
Rock dowel, D25, alternately	Spot, L=3m	@2.5m×2.5m, L=3m	@2m×2m, L=3m	@1.5m×1.5m, L=3m & 6m	@1m×1m, L=4.5m & 6m	@1m×1m, L=4.5m & 6m	@1m×1m, L=4.5m & 6m	@2m×2m, L=3m
Steel support, MB150 (or lattice girder)					@0.8m	@0.8m	@0.8m	
Forepoling grouted dowel,D25mm, @400mm					where necessary	L=6m	L=6m	

Note: (1) *MUS: Maximum Unsupported Span.
(2) For class V rock, the same support scheme as class IV rock can be adopted after grouting is used to improve the integrity and firmness of surrounding rock.

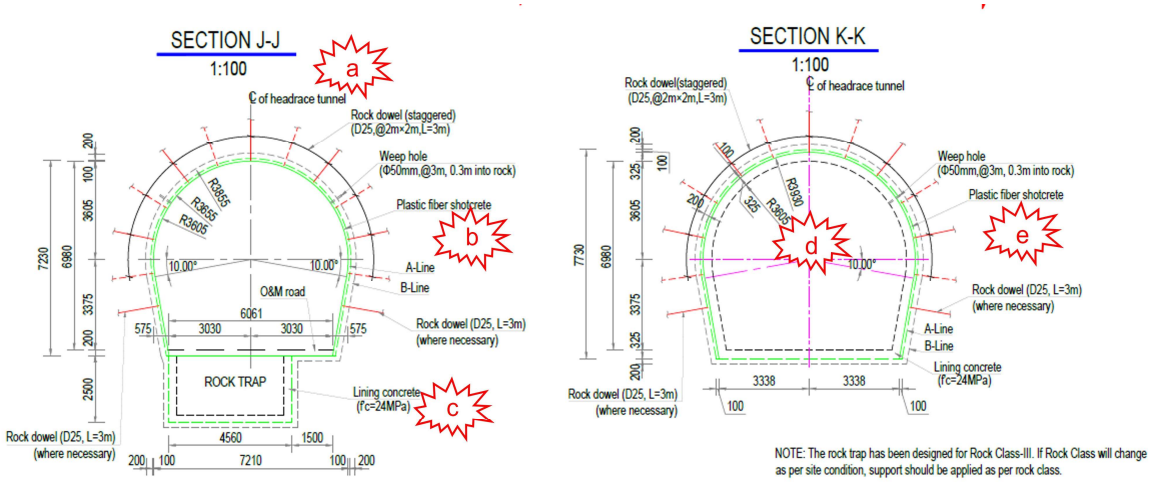
(a) Update table.

(b) Update tunnel support.

Drawing No. UT1-C-150-CVL-DC-54002 (sh. 8/10), version 0A

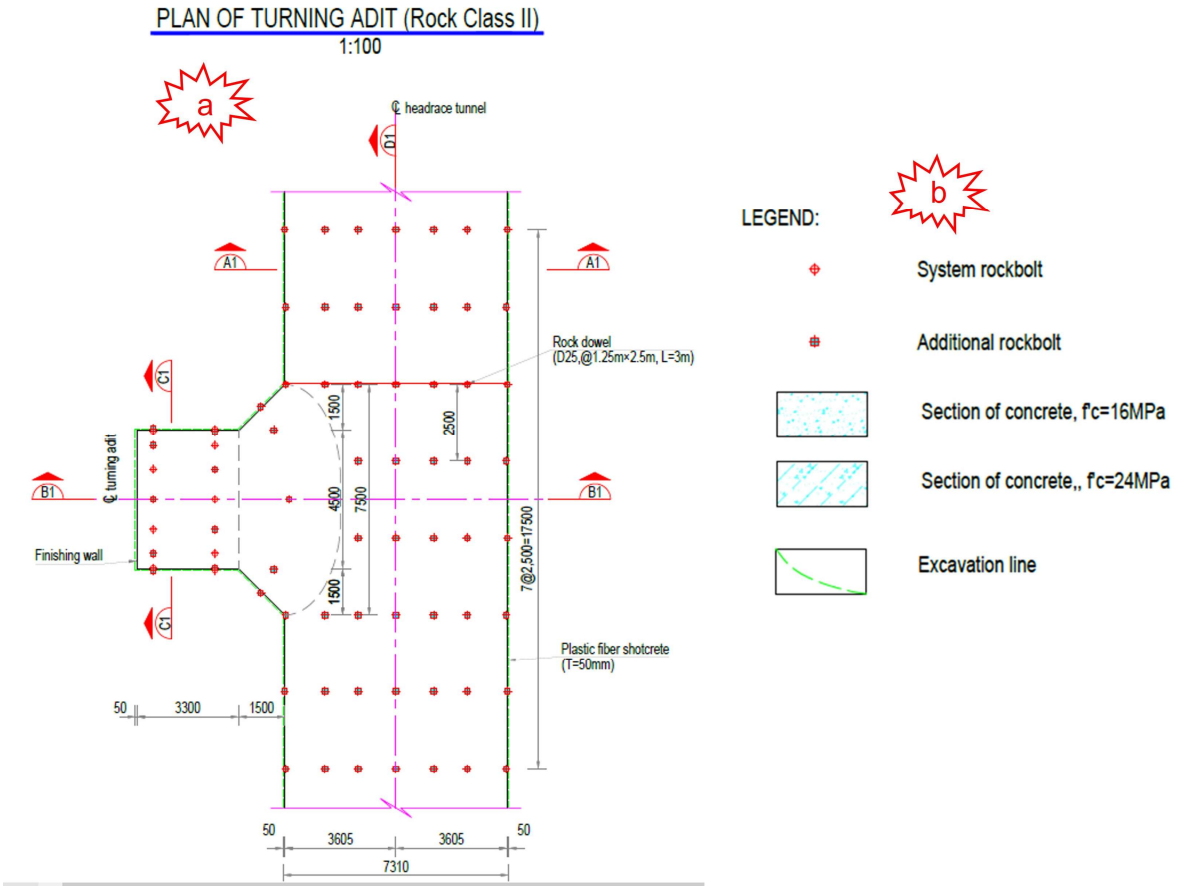


(a) Plan view shows O&M road going through the whole trap. Incorrect. Revise.
(b) Consider whether there is always a concrete lined tunnel section downstream of the trap. Also downstream Trap 1? Consider.
(c) As item (b). Consider.



(a) Clearly specify respective rock class.
(b) Provide thickness of shotcrete.
(c) Rock trap must extend also over entire width of tunnel in the downstream end of trap. Consider. Specify that concrete liner is reinforced.
(d) Thickness of reinforced concrete only 150 mm? Clarify both, thickness of shotcrete and thickness of reinforced concrete.
(e) Clearly specify thickness of shotcrete and reinforced concrete for

Drawing No. UT1-C-150-CVL-DC-54002 (sh. 9/10 and 10/10), version 0A



(a) Clarify that Class II rock requires Class III support in turning bays, and Class II rock requires Class III support.

(b) No concrete liner shown in the drawings, but in legend. Clarify.

Disclaimer:

Any approval will not release the Contractor from any of his obligations under the Contract.

Dr. U. Glawe